Comprehensive Evaluation of RSR Method on the Quality of Higher Education in Jiangxi Province

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Abstract—**Higher education is an innovative talents training base, the educational quality of which directly incarnates quality of talent training and the developmental level of connotation. Through systematic analysis of and comprehensive evaluation to the educational quality of higher education, we could understand the differences between different universities' educational quality, and provide scientific basis by taking reasonable steps to minimize the gap. Using the RSR method and taking the Jiangxi province in the central region as an example, we take seven factors which reflect the level of the higher education as evaluation index to evaluate the educational quality of fifteen universities in Jiangxi province. The results showed that the educational quality of the university was positively related with the university's teachers and graduates' quality in a significant way. Finally, we found deficiencies in some fields of education in universities, and proposed corresponding solutions and recommendations to improve the deficiencies and to promote educational quality.**

Keywords—higher education; educational quality; comprehensive evaluation; RSR

I. INTRODUCTION

The quality of education is the evaluation of the level of education and the effectiveness of teaching. It is directly reflected in the connotation development of university itself, especially the quality of talent cultivation. The main or the core criterion for measuring education quality is the educational purposes and the training objectives of all kinds of schools at all levels. Through the comprehensive evaluation of the quality of college education, it helps to analyze and grasp the quality of talent training in colleges, and proposes corresponding countermeasures and measures for the existing problems. At the same time, it also adopts corresponding measures for various universities to inspire the teachers' inner

motivation and scientific research innovation, and provide more scientific basis for consciously continue to improve the teaching level. Therefore, the research on the comprehensive evaluation of the quality of college education has been self-evident.

Many scholars have conducted intensive and detailed studies on the propositions of evaluation of the quality of college education from different perspectives. Jin Feng [1] collected data through questionnaires and used SPSS and AMOS software to conduct exploratory analysis, confirmatory factor analysis, regression analysis and other methods on data, and conducted empirical research on the key influencing factors of higher education quality. Research shows that the four factors such as university management system, teacher literacy, student literacy and educational resources have a significant impact on the quality of higher education in China. At the same time, domestic and foreign environmental and social factors also have an impact on the quality of China's higher education, but do not reach a significant level. Chen ping Xiao [2] built the core indicators of school-based quality evaluation in vocational colleges from four aspects: personnel training, social services, professional construction, and faculty, and demonstrated their role in school-based quality assessment in detail. Starting from the existing problems in the evaluation system of undergraduate education in colleges and universities, starting from the idea of innovative management and improving the undergraduate education evaluation system in colleges, Xiaozhe Liu [3] proposed how to improve the evaluation system of education quality to promote the connotation development of higher education. Based on a large number of literature readings and analysis, Xiaoqin Nie [4] has integrated five resources that affect the quality of higher education in China (school funding, school facilities, faculty, quality of students, and scientific research conditions). There are ten key principal components in the selection of indicators for the main factors of the five resources, and then two kinds of system cluster analyses are performed on these key principal components to study the differences among

different regions. Based on an empirical analysis of questionnaire surveys in 121 colleges across the country, Yonghong Jia [5] discussed school-related factors affecting the quality of higher education. The results showed that the school-related factors that affect the quality of higher education are educators and educated, education mediation system and the support of the internal environment of the school; the first three are the basic factors that affect the formation of higher education quality, and the latter are the realistic foundation and external conditions that affect the formation of higher education quality. The above research results show that the level of teachers determines the level of scientific research and teaching in colleges, and the quality of students in colleges determines their enrollment rate and graduates' employment quality.

This article mainly uses the rank sum ratio method to comprehensive evaluate the quality of education in 15 colleges and universities in Jiangxi from two aspects (teachers and students' quality) (7 indicators), and aiming at some deficiencies in the field of education, it proposes reasonable solutions and measures from several aspects, which provides a scientific basis for further improving the quality of college education.

II. SOURCES AND METHODS

A. Source of information

The data on the employment of teachers and graduates in this study were obtained from the "2015 report on the quality of higher education in Jiangxi" of the Jiangxi Provincial Department of Education and the "The report on the quality of the 2015 graduates' Employment" provided on the college's website's enrollment and employment information. In order to carry out a comprehensive evaluation of the quality of education in each school in Jiangxi Province, 15 colleges and universities in Jiangxi Province were selected for this study. They were Nanchang University(A), Nanchang Hangkong University(B), Jiangxi University of Finance and Economics(C), Jiangxi Normal University(D), Jiangxi Agricultural University(E), and East China Jiaotong University(F), Jiangxi Science and Technology Normal University(G), East China University of Science and Technology(H), Jiangxi University of Science and Technology(I), GanNan Medical University(J), GanNan Normal University(K), Jingangshan University(L), Yichun University(M), Jingdezhen Ceramic Institute(N), Shangrao Normal University(O). In the comprehensive evaluation of the quality of education in these universities, seven representative evaluation indicators were selected: Full-time teacher-student ratio x_1 (%), Percentage of full-time teachers with professor titles x_2 (%), percentage of full-time teachers with doctoral or master's degrees x_3 (%), Ph.D. Teacher ratio x_4 (%), employment rate of undergraduates x_5 (%), Enrollment rate of college graduates x_6 (%), Graduates abroad rate x_7 (%). The following is a list of the raw data of seven assessment indicators from the 15 universities. see TABLE I.

TABLE I. ORIGINAL DATA ON THE QUALITY OF EDUCATION IN COLLEGES FROM JIANGXI PROVINCE

	x_1 %	x_2 %	x_3 %	x_4 %	x_5 %	x_6 %	x_7 %
A	7.49	52.89	79.31	45.11	88.04	21.82	1.82
B	5.82	47	85	29.68	87.69	18.82	2.37
C	5.22	47.22	67.19	31.90	89.33	11.87	8.34
D	5.67	55.80	72	40.35	88.83	0.04	0.58
E	4.62	54.93	80	27.08	87.89	15	0.37
F	7.39	31.18	67.79	23.77	88.36	7.88	1.41
G	4.74	11.43	68.48	45.12	86.67	13.99	0.44
H	9.33	21.43	51.35	10.71	83.99	9.96	0.48
I	6.67	30	62.15	15	88.61	16.85	0.77
J	6.73	28.57	76.10	7.14	81.54	16.69	0.55
K	5.85	30.59	54.54	25	85.15	12.63	0.41
L	5.81	54.31	71.74	19.06	87	7.61	0.06
M	5.5	45.56	48.23	13.27	88.21	6.51	0.30
N	4.15	52.21	31.82	25.60	87.03	4.22	0.27
O	4.94	36.37	45.33	2.37	86.93	7.36	0.22

B. Evaluation methods

It mainly uses the rank sum ratio method to evaluate the quality of higher education in Jiangxi Province. The rank-sum ratio (RSR) method was proposed by Fengtiao Tian [6], a Chinese scholar, in 1988. The RSR method is a statistical analysis method that combines the advantages of classical parameter estimation and modern non-parametric statistics. It is a brand-new method of statistical information analysis which is a broad-spectrum method in quantitative methods. It has the advantages of strong pertinence, easy operation and obvious evaluation effect. And it is widely used in multi-index comprehensive evaluation, statistical prediction and forecasting, identification and classification, and statistical quality control in the areas of medical and health, science and technology, economy and other fields. The general process of evaluation includes:

(1) Determine high and low indicators. It is easy to know that the seven indicators reflecting the quality of education given above are all high and excellent indicators.

(2) List the original data table and rank it. Calculate the rank-ratio RSR value, rank each index, and calculate the rank-sum ratio according to the formula: $RSR_i = \sum_{j=1}^{m} R_{ij} / mn$ (where R_{ij} is the rank of the j-th column element in the i-th row, m is the index number, and n is the group number). Through the size of the rank sum ratio (RSR) value, the university education quality can be comprehensively sorted. This sorting method using the RSR comprehensive index is a direct sorting method. However, under normal circumstances, it is also necessary to classify the evaluation object. Especially when there are many evaluation objects (15 objects in this study), it is more necessary to sort the files at this time. Therefore, the distribution of RSR should be found first.

(3) Determine the distribution of RSR (calculation of probability units). The distribution of RSR refers to the

cumulative frequency specified by the *probit* expressed in the probability unit, that is,

1) compile the RSR frequency distribution table, list the frequency of each group f , calculate the cumulative frequency of each group $\sum f$;

2) determine the RSR rank range R and the average rank of each group $\bar{R}$;

3) Calculate the cumulative frequency, $\bar{R} \cdot n^{-1} \times 100\%$,and the finally accumulation is corrected by $1 - (kn)^{-1}$;

4) Calculate the downward cumulative frequency $\bar{R} \cdot n^{-1}$;

5) Convert the percentage P into the probability unit *probit* , and the *probit* is for the percentage P corresponding to the standard normal deviation u (pi quintile) plus 5.

(4) Calculate the linear regression equation. The probability unit $probit_i$ corresponding to the cumulative frequency is the independent variable, and the RSR_i value is the dependent variable, and the linear regression equation is calculated as: $RSR = a + b \times probit$;

(5) Filing and sorting. According to the RSR estimated value corresponding to the regression equation, the quality of education in 15 colleges and universities is graded. The classification is based on the standard normal deviation, and the range is better set to -3~3. According to the *probit* value of the probability unit in each bin, the bins are sorted according to the RSR estimated value corresponding to the regression equation. The number of bins is decided by the researcher according to the actual situation.

III. Result

A. Compile the rank of each evaluation object for each indicator (Ri)

The seven evaluation indexes of the 15 colleges and universities selected in this article were ranked according to the index values from small to large, and the ranks of the evaluation objects of each index were obtained, the rank sum ratio (RSR) was calculated, and the value of the rank sum ratio (RSR) was passed.

B. Determine the RSR distribution (calculate the probability units)

The distribution of RSR refers to a specific cumulative frequency expressed by the *probit* value of the probability unit. Percentage P is converted into probability units:

Y= *probit* , Y is for the percentage P correspond to the standard normal deviation u (pi quintile) plus 5; Calculated as follows:

$$p = \bar{R}/n \tag{1}$$

$$p = \phi(u) = 1 - \phi(-u) \tag{2}$$

$$probit = u + 5 \tag{3}$$

Calculate linear regression equation

The probability unit $probit_i$ corresponding to the cumulative frequency is the independent variable, RSR_i is the dependent variable, and the linear regression equation can be calculated by the SAS programming as:

$$RSR = -0.34447 + 0.17217 \times probit \tag{4}$$

C. Filing and sorting

According to the regression equation, the corresponding RSR estimation value is used to sort the evaluation objects. According to the *probit* value of the probability unit in each bin, the bins are sorted according to the RSR estimated value corresponding to the regression equation, and the corresponding probability unit *probit* value is substituted into the RSR estimated value corresponding to the above formula (4). The RSR estimated value for each university is calculated in Table 2 below.

TABLE II.   ESTIMATES FOR RSR

	probit	RSR Val.		*probit*	RSR Val.
A	7.13	0.8831021	I	5.26	0.5611442
B	6.5	0.774635	J	5.09	0.5318753
C	6.11	0.7074887	K	4.57	0.4423469
D	5.85	0.6627245	L	4.83	0.4871111
E	5.63	0.6248471	M	4.15	0.3700355
F	5.43	0.5904131	N	3.89	0.3252713
G	4.83	0.4871111	O	3.5	0.258125
H	4.38	0.4096346			

Divide the evaluation object into four grades, and sort according to the estimated value: From Equation(4), the estimated RSR value is 0.258125 when $probit = 3.5$;,the estimated RSR value is 0.51638 when $probit = 5$;the estimated RSR value is 0.774635 when $probit = 6.5$ .Based on the three critical values, the evaluation results can be divided into four grades. The results are shown in Table 3 below

TABLE III.   CLASSIFICATION AND SORTING OF EDUCATIONAL QUALITY

	P	$probit$	RSR Val	Sorting
I	$\leq P_{6.681}$	≤ 3.5	≤ 0.258125	O
II	$P_{6.681} - P_{50}$	3.5-5	$0.258125 - 0.51638$	NMHKLG
III	$P_{50} - P_{93.319}$	5-6.5	$0.51638 - 0.774635$	JIFEDC
IV	$\geq P_{93.319}$	≥ 6.5	≥ 0.774635	AB

From the sub-files in Table 3, we can see the development of the quality of education in major universities in Jiangxi Province and the overall rankings. Nanchang University and Nanchang HangKong University are excellent grades in the quality of education; Jiangxi University of Finance and Economics, Jiangxi Normal University , Jiangxi Agricultural University, East China JiaoTong University, Jiangxi University of Science and Technology, GanNan Medical University are ranked as good; while other universities have a medium or inferior educational quality rating. At the same time, regression analysis results show that the quality of education in schools is highly linearly related to the quality of faculty and graduates.

IV. DISCUSSION AND SUGGESTION

A. *Analysis of the results*

Through the RSR evaluation and regression analysis of the educational quality data of the 15 colleges in Jiangxi Province, the results show that the quality of college education is significantly related to the quality of faculty and graduates. Several traditional universities such as Jiangxi Normal University, Jiangxi University of Finance and Economics, Jiangxi Agricultural University, and Nanchang HangKong University rank in the top of their education quality, which is in good agreement with the current status of higher education in Jiangxi Province. This shows that the use of the RSR method can make a scientific comprehensive evaluation of the quality of college education.

The SPSS statistical analysis shows that the status quo of college teachers is highly linearly related to their educational quality (correlation coefficient is 0.9267), which indicates that excellent teachers are the key to ensuring the quality of education. At the test level of $P = 0.0001$, the regression analysis was performed on the two sets of data of the RSR_1 values of the comprehensive rank sum ratios and the RSR values of the quality of college education The correlation coefficient between them was $r = 0.8279$, indicating that the two are also highly linearly related. That is to say, the faculty resources in a college are directly related to the quality of education. Therefore, maintaining a reasonable teacher-student ratio and a highly educated teaching staff in colleges has a significant role in promoting the quality of college education.

Using a similar approach , a regression analysis was conducted on the comprehensive RSR reflecting the quality of education and the three variables(graduate employment rate, graduate enrollment rate and graduates abroad rate)reflecting the quality of students in Table 2.At the level of $P = 0.005$, the correlation coefficient between the two is $r = 0.7847$, which indicates that the quality of students can also reflect the quality of education in colleges more significantly [7].

B. *Countermeasures and Suggestions*

The results of the comprehensive evaluation of this article show that the quality of college education is closely related to the construction of the teaching staff, the quality of students, and the institutional mechanisms of education. Here are some suggestions on how to effectively improve the quality of education in universities from these three aspects.

With the continuous expansion of the scale of higher education, the number of teachers in universities has also growing. We can strengthen the construction of teaching staff from the following aspects: (1) Optimize the structure of the teaching staff and strengthen the coordination of educational resources; (2) improve the talent introduction system, to create high-end talent team; (3) improve the level of teacher research, nurture young academic elite; (4)create an innovative team of teachers, build high-level teacher carriers [8].

The quality of students determines the quality of college graduates, and the quality of graduates is one of the important indicators reflecting the quality of college education. Therefore, it is necessary to continuously improve the quality of students and promote the steady improvement of the quality of college education in our province: (1) Scientific orientation Professional disciplines in universities to attract outstanding student resources; (2) Fully develop school education resources and attach importance to promoting quality education; (3) Guide students in employment and entrepreneurship, and encourage students to pursue postgraduate studies [9].

In order to improve the quality of education, it is also need to improve the corresponding educational mechanism system, which provides guarantee for improving the quality of higher education. First of all, the school must improve the teacher evaluation system, increase the assessment of teachers' teaching ability and level, and conduct regular assessments to provide teachers with a guarantee for improving the personal level of the teachers. Second, improve institutional mechanism of the student training model, work hard to cultivate a "idealistic, ethical, cultural, and disciplined" high-quality graduate with dedication and hard work for the country's prosperous and affluent people [10]. Finally, by perfecting the

mechanism for the selection of student sources, we can provide mechanisms and systems for recruiting outstanding students and improving the quality of personnel training in higher education.

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